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No. 05-1120

IN THE

SUPREME COURT OF THE UNITED STATES

COMMONWEALTH OF MASSACHUSETTS, *et al.*,
Petitioners,

v.

U.S. ENVIRONMENTAL PROTECTION AGENCY, *et al.*,
Respondents.

On Writ of Certiorari to the
United States Court of Appeals
for the District of Columbia Circuit

AMICI CURIAE BRIEF OF CLIMATOLOGISTS AND SCIENTISTS SALLIE BALIUNAS, JOHN R. CHRISTY, CHRIS DE FREITAS, DAVID LEGATES, ANTHONY LUPO, PATRICK MICHAELS, JOEL SCHWARTZ, AND ROY W. SPENCER IN SUPPORT OF RESPONDENTS

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INTEREST OF THE AMICI CURIAE

Amici Curiae Sallie Baliunas, John Christy, Christopher de Freitas, David Legates, Anthony R. Lupo, Patrick Michaels, Joel Schwartz, and Roy Spencer are scientists involved in research and/or instruction in climate and related sciences at major universities, intellectual institutions, and federal laboratories. Collectively, they have authored hundreds of articles in the refereed scientific literature, books, book chapters, and other publications on climate and climate change.[1]

Sallie Baliunas is an astrophysicist who earned an A.M. and Ph.D. from Harvard University. Among her research interests are the solar influence on climate and terrestrial ecosystems and the magnetism of the sun and other stars. She has been awarded the Newton-Lacy-Pierce Prize of the American Astronomical Society and the Bok Prize of Harvard University.

John R. Christy is Professor of Atmospheric Science and Director of the Earth System Science Center at the University of Alabama in Huntsville. He received his B.A. in Mathematics from California State University, Fresno and M.S. and Ph.D. in Atmospheric Sciences from the University of Illinois. His research focuses on construction of climate datasets from satellite and in-situ observations. He received NASA's Medal for Exceptional Scientific Achievement and a Special Award from the American Meteorological Society of which he is a Fellow. He is Alabama's State

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[1] Through correspondence filed with the Clerk, the parties have granted consent to this brief; the Solicitor General has consented to this brief by letter, while the other parties' counsel have filed blanket consents to *amicus* briefs. No party or counsel for a party wrote, or contributed to, this brief, nor did anyone other than the *amici* or their counsel pay for or donate to the submission of this brief.

Climatologist and has served on numerous panels (e.g., American Geophysical Union, National Research Council, etc.) including lead authorship duties for the United Nations' Intergovernmental Panel on Climate Change in 2001 and the federal Climate Change Science Program SAP1.1 in 2006.

Chris de Freitas is an Associate Professor in the School of Geography, Geology and Environmental Science at the University of Auckland. He has Bachelors and Masters degrees from the University of Toronto and a Ph.D in climatology from the University of Queensland as a Commonwealth Scholar. At the University of Auckland he has been Deputy Dean of Science, Head of Science and Technology at the Tamaki Campus and Pro Vice Chancellor. He served 10 years as an editor of the international journal *Climate Research*. His research interests cover a variety of themes in environmental climatology.

David R. Legates is Associate Professor of Climatology and Director of the Center for Climatic Research at the University of Delaware in Newark. He also serves as the Delaware State Climatologist. He received his B.A. in Mathematics and Geography, his M.S. in Geography, and his Ph.D. in Climatology from the University of Delaware. He also has served on the faculty at the University of Oklahoma and Louisiana State University. His research focuses on statistical hydroclimatology, which includes precipitation, hydrology, and statistical methodology. In 2002, he won the Boeing Autometric Award for the best paper in image analysis and interpretation from the American Society for Photogrammetry and Remote Sensing.

Anthony R. Lupo is an Associate Professor of Atmospheric Science and Director of Graduate Studies at the University of Missouri in the Department of Soil, Environmental, and Atmospheric Science. He holds a B.S. in

Meteorology from the State University of New York at Oswego, and M.S. and Ph.D degrees in Atmospheric Science from Purdue University. His published research focuses on Atmospheric and Climate Dynamics. He is an expert reviewer on the International Governmental Panel on Climate Change, and he was selected as a Fulbright Scholar to the Russian Academy of Sciences in 2003-2004.

Patrick Michaels is Professor of Environmental Sciences at University of Virginia (on sabbatical leave for 2006-07), and Senior Fellow in Environmental Studies at the Cato Institute. He is past-president of the American Association of State Climatologists, and holds a doctorate in Ecological Climatology from the University of Wisconsin-Madison in 1979. His research interests are climate change and temperature histories, hurricane behavior, and mortality, and he is author of hundreds of scientific, technical, and popular articles on climate change and its impact, as well as four books on the subject, including a recent one discussing the institutional biases created by federal funding of science. He was an author on the climate section "paper of the year" awarded in 2004 by the Association of American Geographers.

Joel Schwartz is a visiting fellow at the American Enterprise Institute, a non-profit, non-partisan think thank, where he studies air pollution policy and science. Previously, Mr. Schwartz directed the Reason Public Policy Institute's Air Quality Project. He has authored numerous policy papers on air pollution trends, control strategies, and health effects. He holds a bachelor's degree in chemistry from Cornell University (1986) and a master's degree in planetary science from the California Institute of Technology (1990). He is a member of the American Chemical Society, the American Geophysical Union, and the Air and Waste Management Association.

Roy W. Spencer is Principal Research Scientist at the University of Alabama in Huntsville; before that he was Senior Scientist for Climate Studies at NASA's Marshall Space Flight Center. He received his Ph.D in meteorology from the University of Wisconsin in 1983. He is co-developer of the first method for precise monitoring of global temperature variations from satellite, work for which he received NASA's Exceptional Scientific Achievement Medal. He is a member of the American Meteorological Society and has provided expert testimony on climate change to Congress on several occasions.

SUMMARY OF ARGUMENT

The *Brief of Amici Curiae Climate Scientists David Battisti, et al., in Support of Petitioners* ("CS Brief") is founded upon the unsupported notion that the net effect of increasing greenhouse gases on human health and welfare is negative. It argues that greenhouse gas emissions "may reasonably be anticipated to endanger public health or welfare," requiring "prompt regulatory action to restrain emissions of greenhouse gases under the Clean Air Act." (p. 10)

But the CS Brief makes no convincing demonstration of this because there is no comprehensive scientific or economic study in the professional literature that has come to this conclusion, factoring in the risks, costs, and benefits of regulation.

The CS Brief relies most heavily on a report from the National Academy of Sciences, *Climate Change Science: An Analysis of Some Key Questions*. By referring to "some" key questions, the title of that report prompts an inquiry into whether "other" key questions were not answered or

discussed. In fact, the core thesis of the CS Brief—that the net effect of current greenhouse gas emissions is harmful to human health and welfare—is not supported by the text of *Climate Change Science*, which explicitly states that the

> costs and risks involved are difficult to quantify at this point and are, in any case, beyond the scope of this brief report (p. 4, J.A. 161).

The mere existence of human-caused climate change itself would not compel regulation; rather, it is necessary to demonstrate that regulation will not cause more harm than good to human health and welfare. While regulation with incomplete data is common, regulation with no data is arbitrary and may even be harmful. In its denial of the petition for rulemaking on carbon dioxide emissions from automobiles, the EPA correctly noted the great "economic and political significance" (Fed. Reg. 52,922, September 8, 2003) of greenhouse gas regulation, compared to existing regulations for other chemicals and substances, and the EPA correctly emphasized the lack of comprehensive knowledge about the effects of prospective regulation. The claims in the CS Brief that harm from carbon dioxide emissions is "virtually certain" (p. 10), and that new studies support that certainty, are simply incorrect.

ARGUMENT

I. Contrary to the Climate Scientists' Amicus Brief, There Is Insufficient Evidence That Carbon Dioxide Emissions Will Endanger Public Health or Welfare

The 2001 National Academy of Sciences report *Climate Change Science: An Analysis of Some Key*

Questions (hereafter, *"Climate Change Science"*), the core document cited by the Climate Scientists, unequivocally states our lack of comprehensive knowledge of the overall effects of human induced climate change:

> The costs and risks involved are difficult to quantify at this point and are, in any case, beyond the scope of this brief report (p. 4, J.A. 161).

Needless to say, this is the "key" question concerning climate change. Prospective individual positive and negative effects can be cited (for example, longer growing seasons vs. possible increases in agricultural pests), but a comprehensive analysis of the risks and benefits of both climate change and regulation (or lack thereof) simply does not exist. (With respect to the latter, see pp. 24-25 below.)

Climate Change Science summarizes the risk factors associated with elevated concentrations of atmospheric carbon dioxide:

> In summary, critical factors in defining a "safe" concentration depend upon the nature and level of societal vulnerability, the degree of risk aversion, ability and/or costs of adaptation and/or mitigation, and the valuation of ecosystems, as well as on the sensitivity of the Earth system to climate change (p. 21, J.A. 205).

Contrast this to the assessment of *Climate Change Science* made in the CS Brief:

> *Climate Change Science* assessed the science holistically and concluded that human-caused climate change had most likely already occurred and that serious future damage was highly probable (p. 21).

One source of uncertainty is that *Climate Change Science* repeatedly references the 2001 *U.S. National Assessment* of climate change, which projects, in its own words, two "very different" globally-averaged temperature increases (2.8 and 4.4°C) for 2100 based upon two "well-regarded models."[2] As is shown below, both of these models are based on assumptions of increases in carbon dioxide concentration that are well-known to be substantial overestimates of what is occurring and what has occurred in recent decades. As a result, these models produce erroneous overprojections of warming for at least the next half-century.

A far better estimate of future warming comes by reconciling climate model projections of the future with real-life data—that is, with the known historical behavior of climate as greenhouse gases have increased. This is because models are more plausible when they are in agreement with actual observations. As is shown below, the expected warming from such increases then becomes 1.8°C for this century, which is clearly below the low end of the *National Assessment's* range.

For comparative purposes, the net warming of the 20th century (See Figure 1) is approximately 0.8°C, or slightly less than half this value. That warming was clearly accompanied by a dramatic improvement in health and welfare, with life expectancies rising more than 60 percent.[3]

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[2] *See* National Assessment Synthesis Team, *Climate Change Impacts on the United States* 17 (2000) ("U.S. National Assessment") (figures given in Fahrenheit; converted to Celsius above).

[3] *See World Almanac 2001* ("Years of Life Expected at Birth, 1900-98," pg. 874); *see also* data from National Center for Health Statistics, http://www.cdc.gov/nchs/data/hus/hus05.pdf (pg. 65, figure 26).

and per-capita income, in constant dollars, increasing tenfold in the United States.[4]

Given that 1.8°C is a more plausible projection of warming over the next century, because it reconciles models and observations, it is difficult to defend the notion that carbon dioxide is a pollutant requiring immediate remediation under the Clean Air Act.

In addition, as shown below, the CS Brief mischaracterizes the effects of greenhouse gases on global temperatures, on hurricanes, on melting of ice and sea-level rise, and on health and mortality. Because of these facts, and the lack of any comprehensive assessment of the risks and benefits of greenhouse gas emissions and regulation, it is simply impossible to conclude that the net effect of greenhouse gases is an endangerment of health and welfare.

II. Contrary to the Climate Scientists' Brief, the Net Effects of Increasing Atmospheric Carbon Dioxide Are Not Known

The CS Brief correctly states that "the basic physics underlying the greenhouse effect is firmly established" (p. 11). There is no controversy about this, and the climatologists and scientists involved in the instant brief do not dispute it. But the CS Brief's subsequent statement, that "greater atmospheric concentrations of greenhouse gases, all other things being equal, cause higher temperatures at the surface" (p. 11), is simply meaningless because in a complicated system such as the atmosphere, all things are *never* equal. It implies that greenhouse gases have an

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[4] *See CIA World Fact Book, 2006* (2005 data) (https://www.cia.gov/cia/publications/factbook/geos/us.html); www.nationmaster.com/graph/eco_gdp_per_cap_in_190-economy-gdp-per-capita-1900DATA (1900 data).

unlimited ability to warm the surface, with no substantial natural negative feedback mechanisms, such as enhancement of low-level clouds that could occur because of greenhouse gases,[5] to moderate this warming. In fact, these mechanisms exist, their effect is highly significant, and some of them may even be strengthened by higher greenhouse gas concentrations.

While greenhouse gases warm the surface of the earth, this surface warming is strongly limited by weather processes such as evaporation and precipitation, convection (the vertical movement of heat away from the surface, as in a thunderstorm), and cloud formation. These weather processes cool the surface temperature about 40°C below where the natural greenhouse effect alone would place it.[6]

The notion that greenhouse gas emissions, mainly of carbon dioxide, contribute to climate change is not in dispute. But the CS Brief goes on to claim that "human activities likely caused *most* of the approximately 0.6°C rise over the 20th century" (p. 12, emphasis added). This is scientifically wrong. Viewing the temperature history of NASA's Goddard Institute for Space Science (headed by James E. Hansen, perhaps the most prominent of the CS Brief *amici*), it is apparent that there were two distinct warmings in the 20th century, with a slight cooling interval between them (Figure 1).

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[5] G.L. Stephens, *Cloud Feedbacks in the Climate System: A Critical Review*, 18 J. Climate 237, 240 (2005)

[6] *See, e.g.*, S. Manabe & R.F. Strickler, *Thermal Equilibrium of the Atmosphere with a Convective Adjustment*, 21 J. Atmospheric Sciences 361, 380-81 (1964).

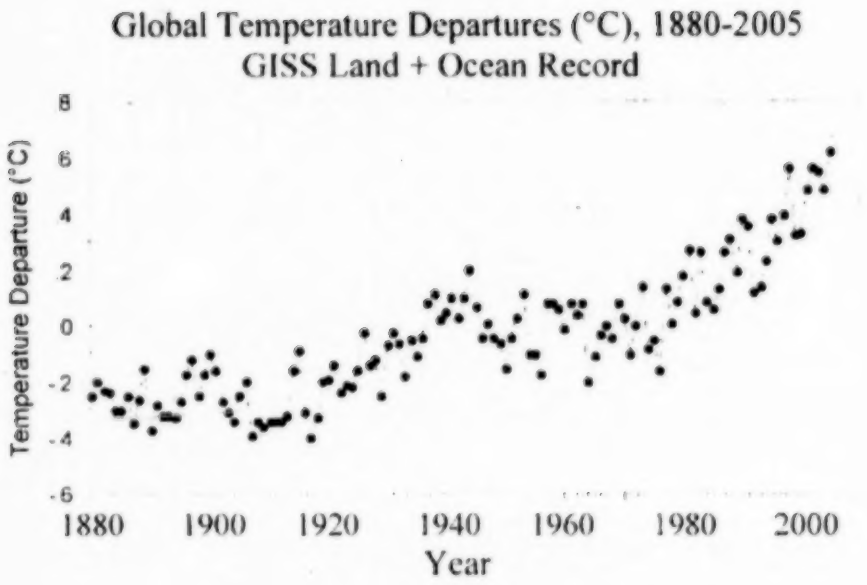

Figure 1. Global Surface Temperature History, NASA Goddard Institute for Space Studies.

The first warming, from 1916 through 1945, occurred before the vast majority of carbon dioxide emissions and therefore is *not* significantly related to greenhouse gas changes. The subsequent cooling occurred during a time of increasing carbon dioxide emissions, compared to the earlier period. The second warming, which began in 1976, is quite possibly a greenhouse warming because of its geographic distribution.[7] The two warming periods were statistically indistinguishable from each other in terms of the amount of warming.[8]

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[7] Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* 10 (2001).

[8] The first warming, from 1916 through 1945, was .150 +/- .014°C/decade (one standard deviation) or a probable range of .136 to .164°C/decade, while the second warming, which began in 1976, was .179 +/- .022°C/decade, or a range of .157 to .201°C/decade. The overlap makes them statistically indistinguishable in magnitude. Temperature data from NASA Goddard Institute for Space Studies (http://data.giss.nasa.gov./gistemp/graphs/Fig. A2.txt).

As shown below, computer models predicting future warming must overestimate warming, because they generally use an incorrect increase in carbon dioxide concentration of 1% per year. The actual increases in the last three decades, based upon the measurement standard at the Mauna Loa Observatory (the most highly cited global carbon dioxide record) *are less than half of this.*[9] Because the models respond quite linearly to changes in atmospheric carbon dioxide with respect to percent (i.e., a 1% change in concentration per year produces roughly twice as much warming as 0.5%), their resulting forecasts must be overestimates.

Covey et al. (2003) have commented upon this rather bizarre approach of knowingly using assumptions at odds with observations:

> The rate of radiative forcing increase implied by 1% per year increasing CO2 is nearly a factor of two greater than the actual anthropogenic forcing in recent decades, even if non-CO2 greenhouse gases are added in as part of an "equivalent CO2 forcing" and anthropogenic aerosols are ignored (see, e.g., Figure 3 of Hansen et al. 1997). Thus the [models' assumed] increasing-CO2 scenario cannot be considered as realistic for purposes of comparing model-predicted and observed climate changes during the past century.

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[9] *See Monthly Average Carbon Dioxide Concentration* (May 19, 2005) (http://cdiac.ornl.gov/trends/co2/graphics/mlo145e_thrudc04.pdf) (data from Mauna Loa Observatory, Hawaii, showing an increase of less than half of a percent per year in carbon dioxide levels); Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, *Atmospheric Carbon Dioxide Record from Mauna Loa* (2005), available at http://cdiac.ornl.gov/trends/co2/sio-mlo.htm (carbon dioxide levels have increased only about 19.4% over the 45 year period from 1959 to 2004. The actual increase during the period was 0.41% per year).

> It is also not a good estimate of future anthropogenic climate forcing, except perhaps as an extreme case in which the world accelerates its consumption of fossil fuels while reducing its production of anthropogenic aerosols.[10,11]

In contrast to this sole reliance on models to the exclusion of observed behavior, a far more logical estimate of future warming comes from reconciling model projections for the future with the known historical behavior of climate as greenhouse gas increases warmed the surface in the past. The result is indeed a constant-rate warming, as predicted by the models, and the rate is 1.8°C/century. That rate, based on actual observations, is shown by the "observed trend" line in Figure 2.

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[10] C.K. Covey et al., *An Overview of Results from the Coupled Model Intercomparison Project*, 37 Global & Planetary Change 103, 104 (2003). Several "Coupled Model Intercomparision Projects" ("CMIP") have been undertaken to evaluate future projections under common conditions. *See id.* The mean warming extrapolated to 100 years is 2.3°C. However, these are run with a 1% per year increase in atmospheric carbon dioxide concentration, which clearly must overestimate warming. The increases in the previous three decades (ending in 2004) have been .49, .42, and .43 % per year, respectively. *See* Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, *Atmospheric CO2 Concentrations* (http://cdiac.ornl.gov/ftp/trends/co2/maunaloa.co2) (May 2005). Because of the long inertia of the climate system (noted by the CS Brief), these overestimates of warming must be accumulating and propagating in the intercompared models through at least 2050. (This inertia was estimated at about 60 years in Schlesinger & Jiang, *Simple Model Representation of Atmosphere-Ocean GCMs and Estimation of the Time Scale of C02-Induced Climate Change*, 3 J. Climate 1297, 1297 (1990)). Because the change in atmospheric concentration shows no evidence for an imminent doubling from its rate for the last three decades, this error very likely continues beyond even 2050.

[11] The two models in the *National Assessment* are included in the CMIP studies. Given their erroneous carbon dioxide increase, they are obviously predicting more warming than will occur through 2050. Thus, they continue the error noted in footnote 10.

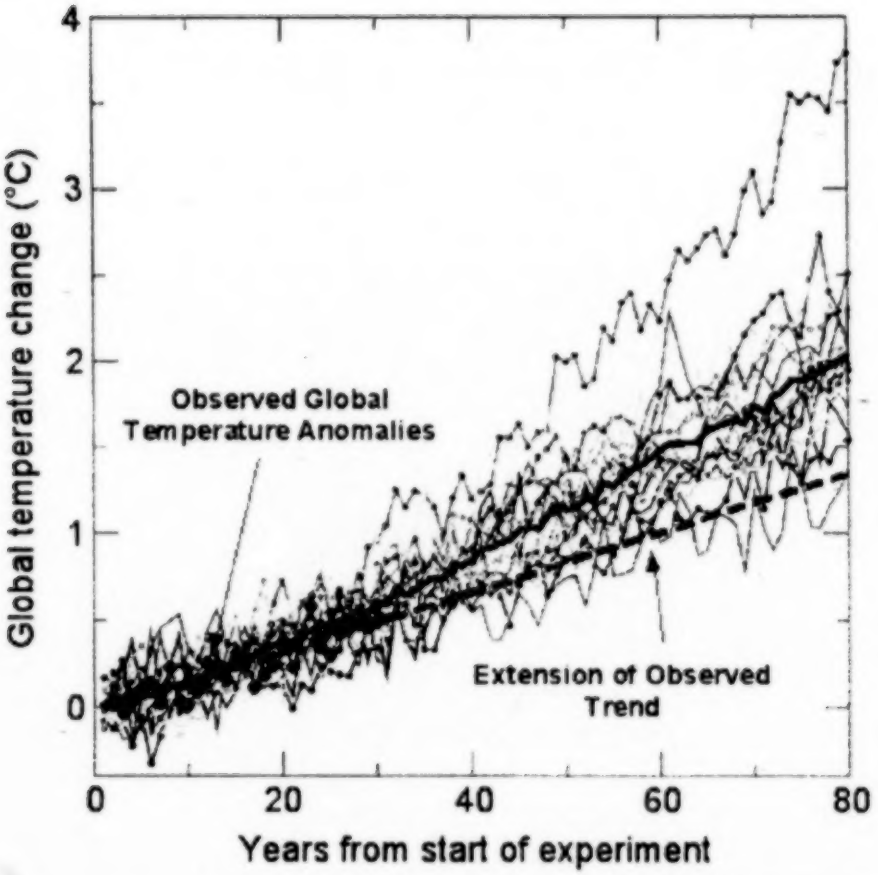

Figure 2. A Typical Model Intercomparision. The spaghetti-like lines are produced by the various climate models.[12] The solid line is the average of the models, which is essentially a constant rate of warming. But this is likely to be an overestimate because the rate of carbon dioxide increase in the models is unrealistically high. The observed warming (dashed line) is also a constant rate, which allows a realistic estimate of future warming (1.8°C to 2100), unless the ensemble behavior of all of these models, projecting constant warming, is wrong. Original

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[12] The models include ARPEGE/OPA2, BMRCa, CCSR/NIES, CCSR/NIES2, CGCM1, CSRIO Mk2, CSM 1.0, DOE PCM, ECHAM3/LSG, ECHAM4/OPYC, GFDL_R15_a, GFDL_R30_c, GISS2, GOALS, HadCM2, HadCM3, IPSL-CM2, MRI1, and MRI2.

figure from *Climate Research*, Vol. 32, p.7 (2006), with circles added in to show observed warming since 1975. Observed data from Intergovernmental Panel on Climate Change (www.cru.uea.ac.uk/cru/data/temperature).

This is far lower than the 2.8 and 4.4°C estimates in the *National Assessment*, which itself is the primary reference in *Climate Change Science*.[13]

This process of reconciling models with observed data is similar to what operational weather forecasters do almost every day. As with long-term climate models, short-term weather models often differ in their predictions. The forecaster "looks out the window" by selecting the model that has performed best in the last few days, or in the last similar forecasting situations. Similarly, climatologists can do this by seeing which models are producing a warming rate that is most consistent with reality (subject to the caveat, noted above at fn. 9-11, that the intercompared models *must* overestimate warming because of the wrong carbon dioxide input).

Interestingly, this warming rate of 1.8°C per century is practically the same as the value calculated by CS Brief

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[13] By relying heavily on this document, both the CS brief and *Climate Change Science* run afoul of the most basic tenet of science: that hypotheses (i.e. models) must be consistent with fact. One of us (Michaels) reviewed the *National Assessment* and determined that both of the models used could simulate observed temperature changes as atmospheric carbon dioxide increased no better than a table of random numbers. This failure was noted by a senior member of the *National Assessment* team, but publication went forward anyway. *See* Michaels, *Science or Political Science?* 184-88 (2003), *in* M. Gough, *Politicizing Science* 171-92 (2003). As the web version of the *National Assessment* prominently notes, this document was "not subjected to OSTP's Information Quality Act Guidelines." (available at http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overview.htm)

scientist *Amicus*, James Hansen. In the 2001 *Proceedings of the National Academy of Sciences*, he wrote:

> Future global warming can be predicted much more accurately than is generally realized...we predict additional warming in the next 50 years of 3/4°C +/- 1/4°C, a warming rate of 0.15°C +/- 0.05° per decade).[14]

In making this calculation, Hansen made clear his assumption that carbon dioxide increases would continue below the consensus range of the IPCC, a fact noted in *Climate Change Science*[15] which, as detailed above, relied on models that clearly overestimate increases in atmospheric carbon dioxide. Clearly, in his own writings, this CS Brief scientist differs from both his fellow *Amici* and the National Academy's *Climate Change Science*.

III. The Climate Scientists' Brief Misstates the Effects of Greenhouse Gases on Hurricanes, Sea Level, Air Quality and Other Climate Factors

The CS Brief argues that changes in hurricanes, sea level, air quality, and other climate factors that they anticipate will be affected by carbon dioxide emissions will

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[14] J.E. Hansen & M. Sato, *Trends of Measured Climate Forcing Agents*, 98 Proceedings of the National Academy of Sciences 14778, 14782 (2001). In making this calculation, Hansen assumed that atmospheric concentrations of methane (which is several times more potent, in terms of temperature effect, than carbon dioxide) would continue to increase at a slowing rate, and then decline. This trend began approximately 20 years ago and ***was completely unanticipated by the climate research community***.

[15] "The increase of global fossil fuel carbon dioxide emissions in the past decade has averaged 0.6% per year, which is somewhat below the range of IPCC scenarios." *Climate Change Science* at 19, J.A. 159.

have the net effect of "endangering human health and welfare." CS Brief at 10.

Hurricanes

The CS Brief predicts a "likely increase in hurricane intensity" (p. 13). In fact, there is no consensus in the current refereed literature that this will occur, or, if it does, whether a change in intensity will even be detectable, given the large year-to-year variation in the natural hurricane climatology.[16]

The most prominent publication in recent years on this subject was by Knutson and Tuleya, in which they projected a 6% increase in maximum surface winds in hurricanes by the year 2080. Despite this projected increase, the authors wrote that "CO2-induced tropical cyclone intensity changes are unlikely to be detectable in historical observations and will probably not be detectable for decades to come."[17] Subsequently, Michaels et al. noted that this simulation overestimated the relationship between warming oceans and strong storm intensity by a factor of five.[18]

The most recent refereed publication on hurricanes is another computer simulation by Bengtsson, et al. They wrote that in their model, projected warming of "between 2

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[16] The consensus view is summarized by the Intergovernmental Panel on Climate Change as follows: "Changes in tropical and extra-tropical storm intensity and frequency are dominated by inter-decadal to multi-decadal variations, with no significant trends over the 20th century evident." IPCC, *Climate Change 2001: The Scientific Basis* 104 (2001).

[17] T.R. Knutson & R.E. Tuleya, *Impact of CO2-Induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization*, 17 J. Climate 3477, 3493 (2004).

[18] P.J. Michaels, et al., *Comments on "Impacts of C02 Induced Warming on Simulated Hurricane Intensity and Precipitation: Sensitivity to the Choice of Climate Model and Convective Parameterization*, 18 J. Climate 5179, 5181 (2005).

and 4°C *has not had any influence on the numbers and intensities of the more powerful tropical storms*" (italics in original).[19]

If current projections of tropical ocean warming of 2-4°F are correct (which itself is debatable), then hurricanes may end up being about 5% stronger by 2100.[20] But the net effect of such changes would be dwarfed by natural cycles of hurricane activity, as well as by huge population and property value increases along the coast.[21]

Climate Change Science itself predates these findings by several years. Moreover, these findings are also absent from the CS Brief, even though it purports to discuss recent developments. *See* CS Brief at 16-17.

Ocean Warming, Arctic Ice, and Sea Level Rise

As evidence for warming, the CS Brief claims that mean ocean temperature rose by 0.05°C from 1955 to 1998. (p. 12). The actual increase is 0.037°C through 1998.[22] A more recent paper by Lyman, et al. shows that, in slightly more than two years, the world's oceans *actually lost 20% of the heat that they had gained from greenhouse gas changes in the last 50 years*.[23] There is no accepted explanation for

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[19] L. Bengtsson, et al., *Storm Tracks and Climate Change*, 19 J. of Climate 3518, 3534-35 (2006).

[20] Knutson & Tuleya, 17 J. Climate at 3493; K. Emanuel, *Response of Tropical Cyclone Activity to Climate Change: Theoretical Basis*, 399 (2004) in R.J. Murnane & K.-B. Liu, Eds., *Hurricanes and Typhoons – Past, Present, and Future* 395-407 (2004).

[21] R.A. Pielke, Jr., *Are There Trends in Hurricane Destruction?*, 438 Nature E11 (2005).

[22] S. Levitus, et al., *Warming of the World Ocean, 1955-2003*, 32 Geophysical Research Letters L 02604 (2005).

[23] J.M. Lyman, et al., *Recent Cooling of the Upper Ocean*, 33 Geophysical Research Letters L 18604 (2006).

this behavior. It, like other observed factors, indicates how much is still unknown in climate science. See also fn.14.

The CS Brief contends that Arctic ice decreased about 10-15% since records first became available. The citation in their brief (p.16) is Comiso, 2006, which describes the satellite-based history, which begins in 1979.[24] But as Serreze et al. and Polyakov et al. show, 1979 comes at the end of the second-coldest period in the Arctic in the 20th century, and the coldest since the 1920s.[25] This means that the decrease cited by the CS Brief *must have started at a maximum point for Arctic ice*. In short, a decrease in ice coverage was to be expected given that unrealistic baseline.

Wood and Overland examined the logs of Arctic exploration vessels in the 19th century to determine ice-edge minima. They found them to be very similar to current ice minima.[26] In short, by neglecting the historical perspective of the satellite data, the CS Brief gives an unjustifiably extreme perspective.[27]

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[24] J.C. Comiso, *Arctic Warming Signals from Satellite Observations*, 61 Weather 70-76 (2006).

[25] M.C. Serreze, et al., *Observational Evidence of Recent Change in the Northern High-Latitude Environment*, 46 Climatic Change 159, 167 (2000); I.V. Polyakov, et al., *Trends and Variations in Arctic Climate Systems*, 18 EOS Transactions of the American Geophysical Union 1.01878, p. 2 (2002).

[26] K. Wood & J.E. Overland, *Accounts from 19th-Century Canadian Arctic Explorers' Logs Reflect Present Climate Conditions*, 84 EOS Transactions of the American Geophysical Union 410, 410 (2003).

[27] While melting of the Arctic polar ice sheet would not raise sea levels because most of the ice sits on water (except Greenland), the Antarctic ice sheet mostly sits on the Antarctic continent. Significant melting there could therefore cause sea levels to rise. British Antarctic Survey temperature stations show a warming trend in the Antarctic Peninsula (much of which is north of the Antarctic Circle) and stable or cooler temperatures over most of the continent. *See* British Antarctic Survey web site, *Antarctic near-surface temperature trends, 1951-2004*. http://www.nerc-bas.ac.uk/public/icd/gjma/trends2004.col.pdf. "Antarctic

The CS Brief warns about "anticipated sea level rise" (p. 13) without any quantification. The 2001 IPCC report estimated a median sea level rise to 2100 of 19 inches. This, however, was based on inputs of carbon dioxide and other greenhouse gases that are now known to be erroneously high. (See Footnotes 9 & 10). Moreover, its predictions of ice loss from nonpolar sources are also now viewed as overestimated, as shown in Raper et al.[28]

Even if one accepts the 2001 report's estimate of a 19 inch rise over the next century, it is unknown whether this will, on net, harm human health and welfare. In fact, owing more to geological than climatological considerations, sea level rose at an even faster rate in the *previous* half-century (i.e., "naturally") along the U.S. east coast.[29] It has never been demonstrated that even this substantial change exerted a net harm on human health and welfare, given that coastal property values rose exponentially during this time. Obviously, people easily adapted to this rate of rise. In light of this history, one simply cannot assert that sea level rise results in a net endangerment of human welfare.

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near-surface temperature trends, 1951-2004." The Antarctic ice sheet has actually been thickening in the period from 1980 to 2004, according to Van de Berg, et al., *Reassessment of the Antarctic Surface Mass Balance Using Calibrated Output of a Regional Atmospheric Climate Model*, 111 Journal of Geophysical Research D11104 (2006).

[28] S.C.B. Raper & R. Braithwaite, *Low Sea-Level Projections from Mountain Glaciers and Ice Caps Under Global Warming*, 439 Nature 311, 311 (2006).

[29] C. Cabanes, et al., *Sea Level Rise During the Past 40 Years Determined from Satellite and In Situ Observations*, 294 Science 840, 841 (2001).

Air Quality

The CS Brief claims that "ground level ozone ("smog") levels (and associated risks to human health) are very likely to increase with temperature, especially in the Northeastern United States, where many areas currently experience ozone levels that exceed EPA Clean Air Act standards on hot summer days." (CS Brief at 14). This claim is incorrect, incomplete, and misleading.

During the last few decades, temperatures have risen but air pollution levels have declined—exactly the opposite of what the CS Brief claims should have happened. According to the National Climatic Data Center, the average summer (June-August) temperature in the U.S. rose about 0.5°F between 1980 and 2005.[30] However, during the same time period national-average 8-hour ozone levels dropped 20% and national 1-hour ozone levels dropped 28%.[31] Ozone exceedance days per year dropped even more than ozone levels. Over the same period, 8-hour ozone exceedances per year dropped 79% while 1-hour ozone exceedance days dropped 94%.[32] In other words, *higher temperatures have been accompanied by lower ozone levels.*

The CS Brief does not explain why we should expect the future to be the opposite of the past. Indeed, it does not even mention this ongoing improvement in air pollution levels.

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[30] National-average temperature data for June-August downloaded from the National Climatic Data Center, U.S. Department of Commerce: http://www.ncdc.noaa.gov/oa/climate/research/cag3/html.

[31] Average for continuously-monitored sites around the U.S. Data prepared by the U.S. Environmental Protection agency, downloaded from http://www.epa.gov/airtrends/ozone/html.

[32] Average for continuously-monitored sites around the U.S. Data prepared by the U.S. Environmental Protection Agency, available at http://www.epa.gov/ttn/airs/airsaqs/detaildata/downloadaqsdata.htm.

Extreme Weather Events

The CS Brief asserts that "rising temperatures are also likely to lead to increases in extreme weather events, especially heat waves, and associated heat-related deaths." (p. 14). But people living in warmer climates can better anticipate and adapt to those conditions, as shown by Davis et al. His research demonstrates that heat wave-related mortality is declining rapidly in North American cities, and that cities that are naturally the hottest have the lowest base-level heat-related mortality.[33] The reason is that where heat is more frequent, people adapt better to it.

The corollary is that where heat waves are rare, heat-related mortality is higher.[34] In North America, where almost all major cities are south of 60°N, virtually the entire urban population would, under scenarios of strong warming, experience progressively less heat-related mortality.

Moreover, cold-related mortality exceeds heat-related mortality, and it is not confined to cold waves or those who fail to anticipate them.[35]

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[33] R.E. Davis, et al., *Decadal Changes in Summer Mortality in U.S. Cities*, 47 Int'l J. of Biometeorology 166, 172 (2003); *see also* Anthony R. Wood, *Warming Won't Devastate, Researchers Say*, Philadelphia Inquirer, June 14, 2004, at E3 ("Heat-related deaths actually declined from the 1960s to the 1990s") (available at 2004 WLNR 19349000).

[34] *See* R.E. Davis, et al., *Changing Heat-Related Mortality in the United States*, 111 Environ. Health Perspect. 1712 (2003).

[35] *See, e.g.*, Intergovernmental Panel on Climate Change, *Climate Change 2001*, Chapter 9.4.2 (admitting that "several studies indicate that decreases in winter mortality may be greater than increases in summer mortality under climate change," and that "limited evidence indicates that, in at least some temperate countries, reduced winter deaths would outnumber increased summer deaths") (http://www.grida.no/climate/ipcc_tar/wg2/353.htm); H.G. Ansleigh, *Beneficial Effects of Sun Exposure on Cancer Mortality*, 22 Preventive Medicine 132 (1993) (colder cities have higher overall cancer rates than warmer cities);

The CS Brief also claims that rising temperatures will result in more extreme weather events, and in altered patterns of rainfall (e.g., droughts and floods) "that will disrupt natural and agricultural ecosystems and increase the risk of extinction for animal and plant species." CS Brief at 14.

But the IPCC's 2001 report indicates that precipitation increases are less than 1% per decade over the mid-latitudes – a figure that is dwarfed by the natural variability in precipitation.[36] In a subsequent study, New et al. concluded that terrestrial precipitation over the habitable regions of the globe increased only by 9 mm (0.35 inches) over the past century – or less than 1 mm per decade, and concluded that few regions of the world show marked trends in precipitation.[37]

Changes in precipitation frequencies are more difficult to assess. Nonetheless, for the United States, Kunkel, et al. found that the frequency of heavy precipitation for the latter twentieth century was comparable to that which occurred in the late nineteenth and early twentieth centuries.[38]

Christopher R. Adams, Colo. State U., *Impacts of Temperature Extremes* (http://sciencepolicy.colorado.edu/socasp/weather1/adams.html) ("The average number of deaths attributed to cold is 770 yearly, substantially higher than the number attributed to heat," and roughly double the number of heat-related deaths), *citing* E. Kilbourne, *Heat Waves and Hot Environments* (1997) *in* E. Noji, *The Public Health Consequences of Disasters* 245-286 (1997).

[36] Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* 142 (2001).

[37] M. New, et al., *Precipitation Measures and Trends in the Twentieth Century*, 21 Int'l J. Climatology 1899, 1899 (2001).

[38] K.E. Kunkel, *Temporal Variations of Extreme Precipitation Events in the United States: 1895-2000*, 30 Geophysical Res. Ltrs. 1900 (2003).

IV. Contrary to the Climate Scientists' Claims, Discrepancies Between Satellite and Surface Temperature Data Still Exist, and the Historical Significance of Recent Temperatures Remains in Dispute

The CS Brief argues that, since the publication of *Climate Change Science*, the "apparent discrepancy" between surface and satellite temperature records "has been resolved." This discrepancy involved the fact that the climate models projected a greater increase in the average temperature of the troposphere (roughly the bottom 8 miles of the atmosphere) than in surface temperatures. The satellite data failed to show this. This discrepancy indicated a basic flaw in the models. But according to the CS Brief, now "all available data sets show that both the surface and the troposphere have warmed." (CS Brief at 17).

But the fact that the two records both show warming does not automatically mean that they are not in conflict. The most current research supports the continued existence of a discrepancy and its serious implications for model simulations.[39]

The CS Brief claims that, since the NAS/NRC 2001 and 2002 reports, a more recent NAS/NRC report (*National Academy of Sciences: Surface Temperature Reconstructions for the Last 2,000* years) concluded that "the global mean

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[39] J.R. Christy & R.W. Spencer, *Correcting Temperature Data Sets*, 310 Science 972 (2005); J.R. Christy & W.B. Norris, *Satellite and VIZ-Radiosonde Intercomparisons for Diagnosis on Non-Climatic Influences*, 23 J. Atmospheric & Oceanic Tech. 1181 (2006); J.R. Christy, et al., *Methodology and Results of Calculating Central California Surface Temperature Trends: Evidence of Human-Induced Climate Change?*, 19 J. Climate 548 (2006); J.R. Christy, et al., *Tropospheric Temperature Change Since 1979 from Tropical Radiosondes and Satellite Measurements*, 111 J. Geophysical Research __ (in press).

surface temperature during the last few decades was higher than in any comparable period in the past four centuries, if not in the past 1000 years." CS Brief at 16-17.

In fact, this new report raises serious questions about the reliability of reconstruction techniques. Subsequent to the NAS report, the Energy and Commerce Committee of the House of Representatives solicited a report on this matter from Dr. Edward Wegman, Chair of the National Academy of Sciences Committee on Applied and Theoretical Statistics. Wegman reported that

> the assessments that the decade of the 1990s was the hottest decade in a millennium and that 1998 was the hottest year in a millennium cannot be supported ....The paucity of data in the more remote past makes the hottest-in-a-millennium claims essentially unverifiable.[40]

In short, it is impossible to verify claims that the earth is in the midst of an unprecedented heat wave.

V. History Demonstrates that Restricting Greenhouse Gas Emissions in the Past Would Have Greatly Harmed Humanity

The effects of greenhouse gas emissions are not a new subject. In 1896, the Swedish chemist Svante Arrhenius published, in the journal *Philosophical Transactions*, the seminal paper on the effects of higher carbon dioxide on temperature. He predicted that a doubling of its atmospheric

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[40] http://energycommerce.house.gov/108/home/_07142006_Wegman_Report.pdf

concentration would lead to an average surface temperature increase of slightly over 5°C.[41]

His prediction would seem to pose a problem for humanity. After all, atmospheric carbon dioxide was demonstrably increasing. Moreover, the regional surface had warmed, as evidenced by the retreat of midlatitude glaciers in Europe between the mid- 19th and 20th centuries.[42]

The CS Brief argues that:

> In...climate science...critical decisions must be made in a timely fashion to protect the health and welfare of the population...without the false luxury of waiting for damage to be observed (p. 21).

By this logic, however, carbon dioxide restrictions would have been imposed at the turn of the last century. As a result, the world would have lost many of the benefits of industrialization, from advances in transportation, agriculture, and technology to the scientific progress made possible by the expanding capital of growing economies. The dramatic increase in life expectancy over the last century occurred largely in those nations which might, under the CS Brief's approach, have imposed such emission restrictions.[43] But had this occurred, these nations' economies could not have developed anywhere near as rapidly, given the resulting restrictions on using fossil fuels. It is fossil fuels that enabled the Industrial Revolution to occur on the scale that it

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[41] Arrhenius, *On the Influence of Carbonic Acid in the Air Upon the Temperature of the Ground*, 41 Phil. Transactions 237, 266 (1896).

[42] E.L. Ladurie, *Times of Feast, Times of Famine: A History of Climate Since the Year 1000* plate xxi and xxii (1971).

[43] *See* National Institute on Aging, Population Reference Bureau, *The Future of Human Life Expectancy* 1 (March 2006) (available at http://www.prb.org/pdf06/NIA_FutureofLifeExpectancy.pdf) ("life expectancy . . . has nearly doubled in the past century").

did. Much of what was gained in the last 100 years would have never been, and no one would have been the wiser.

CONCLUSION

The CS Brief is quite wrong to argue that the "evidence supporting such a determination [that greenhouse gas emissions 'may reasonably be anticipated to endanger public health or welfare'] is compelling." The net effect of greenhouse emissions on human health and welfare is unknown and has not been comprehensively determined, even as the technological and scientific advances associated with those emissions have dramatically increased life expectancy. The CS Brief mischaracterizes the effects of greenhouse gases on the globe's temperature history, on hurricanes, on melting of ice and sea-level rise, and on health and mortality. Because of these facts, it is simply impossible to conclude that the net effect of greenhouse gases endangers human health and welfare.

For these reasons, the decision below should be affirmed.

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